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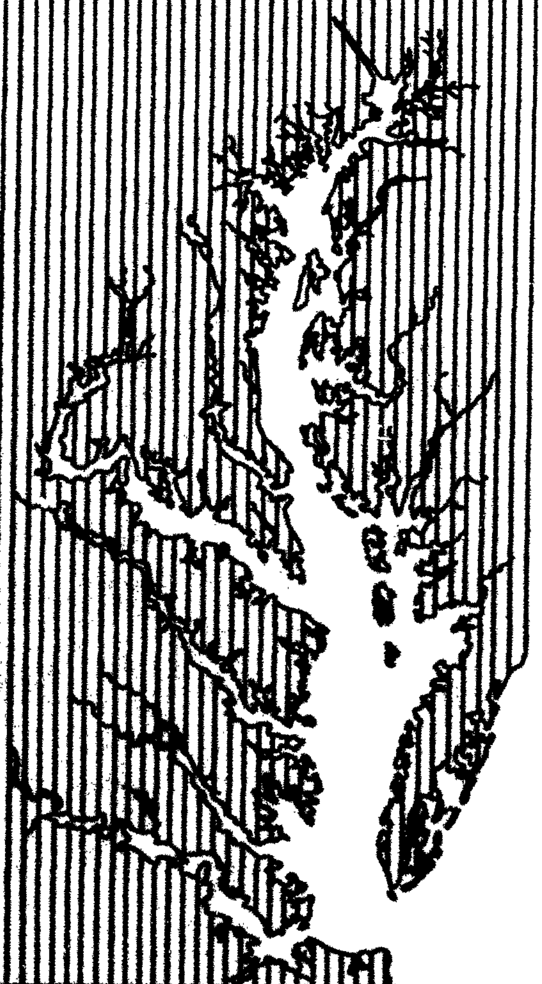

Inshore Survey Program
Interim Report XVI

REPORT ON CORES AND SCOOPFISH SAMPLES FROM THE SOUTHERN APPROACH CHANNEL

by

M.C. Powers

Reference 53-2
January 1953

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CHESAPEAKE BAY INSTITUTE
THE JOHNS HOPKINS UNIVERSITY

INSHORE SURVEY PROGRAM

INTERIM REPORT XVI

REPORT ON CORES AND SCOOPFISH SAMPLES FROM THE SOUTHERN APPROACH CHANNEL

By

M. C. Powers

This report contains results of work carried out for the Office of Naval Research of the Navy Department under Project NR 084-005, Contract Nonr 248(07), and for the U. S. Navy Hydrographic Office.

Reference 53-2
January 1953

Wayne V. Burt
Project Supervisor

INTRODUCTION

This report presents the preliminary laboratory analysis of underway bottom samples and core samples from the southern approach channel to the Chesapeake Bay. The location of the channel was selected by the Hydrographic Office and submitted to the Chesapeake Bay Institute. The investigation of the sediments is required to include size analysis of the sediments, a megascopic logging of the cores, pH measurements, organic analysis, and textural analysis of the sands. Field work was done aboard the USC&GSS PARKER commanded by Commander G. C. Mast.

ANALYTICAL PROCEDURE

Underway Bottom Samples

Underway scoopfish samples have been analyzed in the laboratory according to the following method. The color of the sediment was determined by comparison with a standard color chart published by the National Research Council. Samples of 40 to 50 grams were oven-dried, disaggregated, and sieved with 2.0, 0.5, 0.25, and 0.062 millimeter sieves. The volumes of material remaining on these sieves and the fractions passing through the 62 micron sieve were measured with 15 milliliter centrifuge tubes graduated to one tenth of a milliliter. The per cent volume was calculated and plotted on arithmetic probability paper. Median diameters were read from the graph as the phi values corresponding to the 50 per cent volume abscissae.

Core Data

Data from the preliminary analysis of 55 cores taken on the southern approach channel are included in this report. The cores were wet logged, particular attention being paid to grain size, color, shell content, and mineral composition. A fifty gram sample from the top of each core was subjected to size analysis. The per cent by weight of calcium carbonate was measured. Wet density was determined with a MUDWATE hydrometer. Natural water content was determined by the oven-drying technique. pH was determined in the field with pHydrion paper.

Two different sorts of cores exist and require different procedures for determining Rd, wet density, and natural water. They are cores from which a large part of the interstitial water is lost and cores which, with careful handling, retain most of the interstitial water. An experienced operator seldom has any difficulty in assigning a core to its correct class. Clean sands under water are usually close packed and saturated with water and yield cores of the first sort. Muddy sands and muds produce cores of the second sort for which the Rd, wet density, and natural water may be determined directly on the material as taken from the core. The modification in procedure necessary to obtain measures approximating the *in situ* values for the first sort is to prepare the sample by close packing it and saturating it with water.

Plotting the Data

The plate (last page) shows the bottom profile of the southern approach channel along which the cores have been plotted as columnar sections. The symbols inside the columns give a description of the sediment based on the megascopic log. Wet density is shown to the left of the column and pH to the right, the numbers appearing at the level at which the measurements were made. Per cents by weight of calcium carbonate for the 0 - 6" core-sections where these have been determined are placed just above the columnar sections while the core numbers appear below the columns. The colors of the wet sediments based on scoopfish and core samples are written above the profile. The median diameters of scoopfish and core samples for the 0 - 6" sections and the Rd values are plotted above the profile. The core median diameters have been connected by a continuous line while the scoopfish median diameters are shown as triangles. From such a plot one may visualize how nearly the sampling methods correspond and how the properties vary along the profile.

RESULTS

Color

There are increasing amounts of brown and yellow colors in the sediments with distance from shore which is probably due to a more complete oxidation of the ferrous coatings on the sand grains.

Shell Accumulation

Cores containing shells show a preferred depth for the accumulation of these shells. The depth is not uniform from core to core nor is there any readily apparent connection in the variations in shell depth between core locations.

The thickness of the layer of shell accumulation may range from a few inches to several feet and appears to depend on the size distribution of the sediments. It is characteristic of mud cores to have a shell accumulation only a few inches thick located at or near the top while for sand cores the layer of shell accumulation usually begins at two to five feet below the surface. How thick these latter accumulations may be, we do not know as our coring gear does not pass entirely through them.

Complete and broken shells of pelecypods, gastropods, corals, and razor clams are found in the cores together with tests of foraminifera, bryozoa, and diatoms. The foraminifera, because of their small size, are concentrated toward the top. It is significant that some of the more delicate shells, those of the razor clam, for example, may be found intact. The accumulations range in age from fossil to recent, the fossils and some of the more recent shells being detrital. There is no evidence of a time break in the deposits.

Two facts make it unlikely that these shell accumulations were covered by normal deposition. First, they are poorly sorted, and second, they are oriented in a random fashion. Schrock[1] holds that earthquakes account for randomly oriented shell accumulations. To us it seems more reasonable to suppose that the shells settled through the sediment. A mechanism to account for this settling is provided by the traction zone.

The traction zone is a layer of sediment which is kept in continuous or occasional motion by the overlying water. Its thickness depends upon the density

1 Shrock, R.R.: Sequence in Layered Rocks, McGraw Hill, New York, pp. 305-315, 1948.

of the water, the pressure variations on the bottom, and the velocity of the current in the water, as well as on the density, size distribution, and nature of the sediments being acted upon. The zone is thinner for muds and thicker for clean well sorted sands. Although we do not have exact knowledge of the phenomenon, it would seem probable that the combined lifting action of passing swells coupled with the lateral action of currents is sufficient to accomplish vertical sorting in the traction zone. At least, nearly all cores from the shelf show graded bedding with depth toward coarse sand and pebble sizes.

From this point of view, shells settling from the water would be sorted downward to the level appropriate to their size. Since shells and shell fragments are greater than most sediment sizes involved, this would bring them to the base of the traction zone where, over long periods, the accumulation would become quite thick. The level of shell accumulation may then be taken as the level of the base of the traction zone.

A similar argument may be made for pebbles. We do in fact find pebbles mixed with the shells in the layer of shell accumulation.

It is evident that any object lying on the bottom will be acted on in the same way as the shells and the pebbles and will, if large enough and heavy enough, come to rest at the base of the traction zone. It would seem possible that this action might take place swiftly enough to be of interest in the case of the sinking of air dropped mines, where their initial impact did not carry them below the base of the traction zone. In that case the layer of shells would mark the depth at which the mine would come to rest. It is well to note that since swell is generally absent in bays and estuaries, the traction zone is usually thinner than in exposed areas. Mines would therefore sink further in sand bottoms in exposed areas than in the same type sediment in protected bays and estuaries.

The traction zone is not the only mechanism by which shells may settle through a sediment. For example, muddy sediments are sometimes coated with an overlying layer of gelatinous organic ooze. This material has a water content in excess of 200 per cent and wet density values around 1.2. A layer of this gelatinous ooze two feet thick would shrink to less than three inches if all the absorbed water were eliminated. Such material offers little resistance to the settling of shells and pebbles.

Sediment Median Diameters

The scoopfish median diameter is usually a little larger than the corresponding core median diameter since fine fractions wash out more readily from the scoopfish than from the coring tube. In a majority of cases, however, the scoopfish median diameter is very close to its corresponding core median diameter. Where anomalies exist, as in cores 649R8 and 646BB10, the core median diameter is taken to be in error since surrounding scoopfish median diameters fall into a smooth curve. Differential settling of particles in the core liner following handling and jostling may sometimes result in smaller median diameters for the top of the core than the actual in situ values. It is apparent that scoopfish data alone would give a reasonable account of the median diameters along the southern approach channel. If the scoopfish data replace those from the two anomalous cores (core 649R8 and 646BB10), the median diameters are seen to vary little along the complete course of the channel. If the two cores mentioned above are excluded, 87 per cent of the core median diameters fall between 0.50 and 0.18 mm, a range of only 0.32 mm. These sediments are therefore very well sorted with respect to their median diameters.

Rigidense

On the graph Rd has been plotted on a scale numerically equal to the phi scale used for the median diameters. One can see that the rigidense values do not deviate greatly from the corresponding phi median diameters. The Rd's are usually slightly less than median diameters since they are normally controlled by smaller diameters than the mode or median. Where Rd occurs well above the median diameter, shell content or pebbles are frequently the cause. Where Rd occurs well below the median diameter, the sediment usually contains some silt or clay. Relations of Rd to sediment parameters have been discussed in Special Report 2 (Reference 52-24). Rigidense agrees with the scoopfish data corresponding to the anomalous cores 649R8 and 646BB10.

pH

pH of the shelf sediments is remarkably constant at 6.75 ± 0.25.

The question of whether pH values will change appreciably during the time necessary to make measurements has been raised. When strongly reduced sediments are exposed to the atmosphere, they will oxidize, usually causing dark

Calcium Carbonate

The per cent of calcium carbonate varies randomly, but is generally rather low, 1.5 to 4.0 per cent. Occasional anomalously high carbonate contents occur along the course of the profile. There does not seem to be any relation between these anomalies and bottom topography.

Natural Water

In the typical shelf core which is composed of well sorted, clean sand, the water content in 85 to 90 per cent of the cores is between 20.0 and 25.0 per cent. About 99 per cent of all of the cores from the shelf have a water content between 17 and 30 per cent. These persistently low values for water content attest to the well sorted nature of the shelf sediments in general, and they rule out the possibility of silt and clay size particles in the sediments in excess of about five per cent.

Porosity

When we measure natural water, we are in fact measuring the pore space.

$$\text{Water content} = \frac{\text{Weight of water}}{\text{Weight of sediment}} \times 100 \text{ (Weight of water} = \text{pore space)}$$

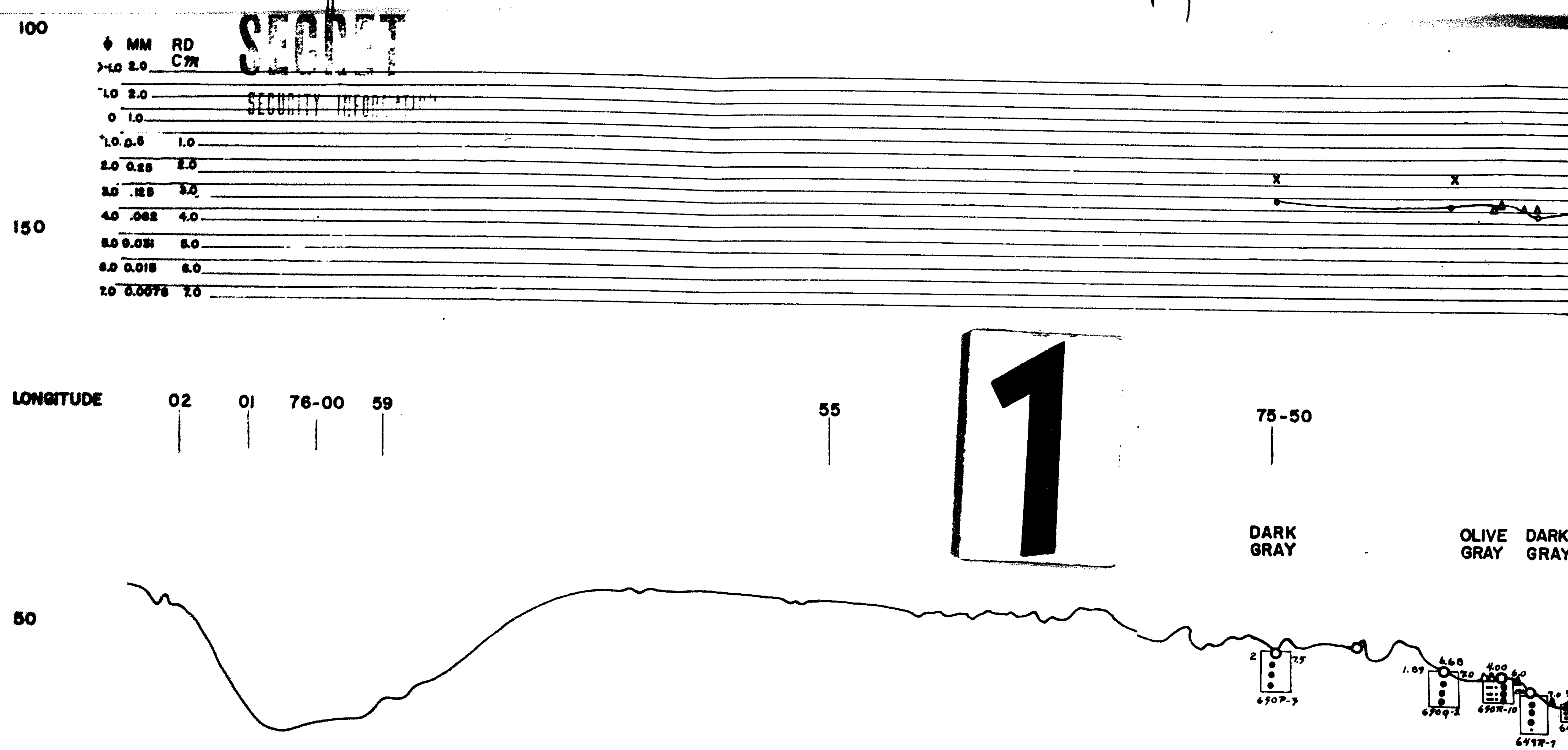
If the sediment is assumed to be saturated with water and the solids are assumed to have a specific gravity of 2.7, porosity can be calculated by the following relationships:

$$\text{(1) Per cent water} = \frac{100 \times \text{Natural water}}{100 + \text{Natural water}}$$

$$\text{(2) Porosity} = \frac{\text{Per cent water}}{\text{Per cent water} + \left(\frac{100 - \text{Per cent water}}{2.7}\right)}$$

Evaluation of Channel Locations

The evaluation of these data from core and scoopfish samples shows no sediment conditions which would interfere with the purpose for which the southern approach channel was selected and it may, therefore, be considered to be well located.



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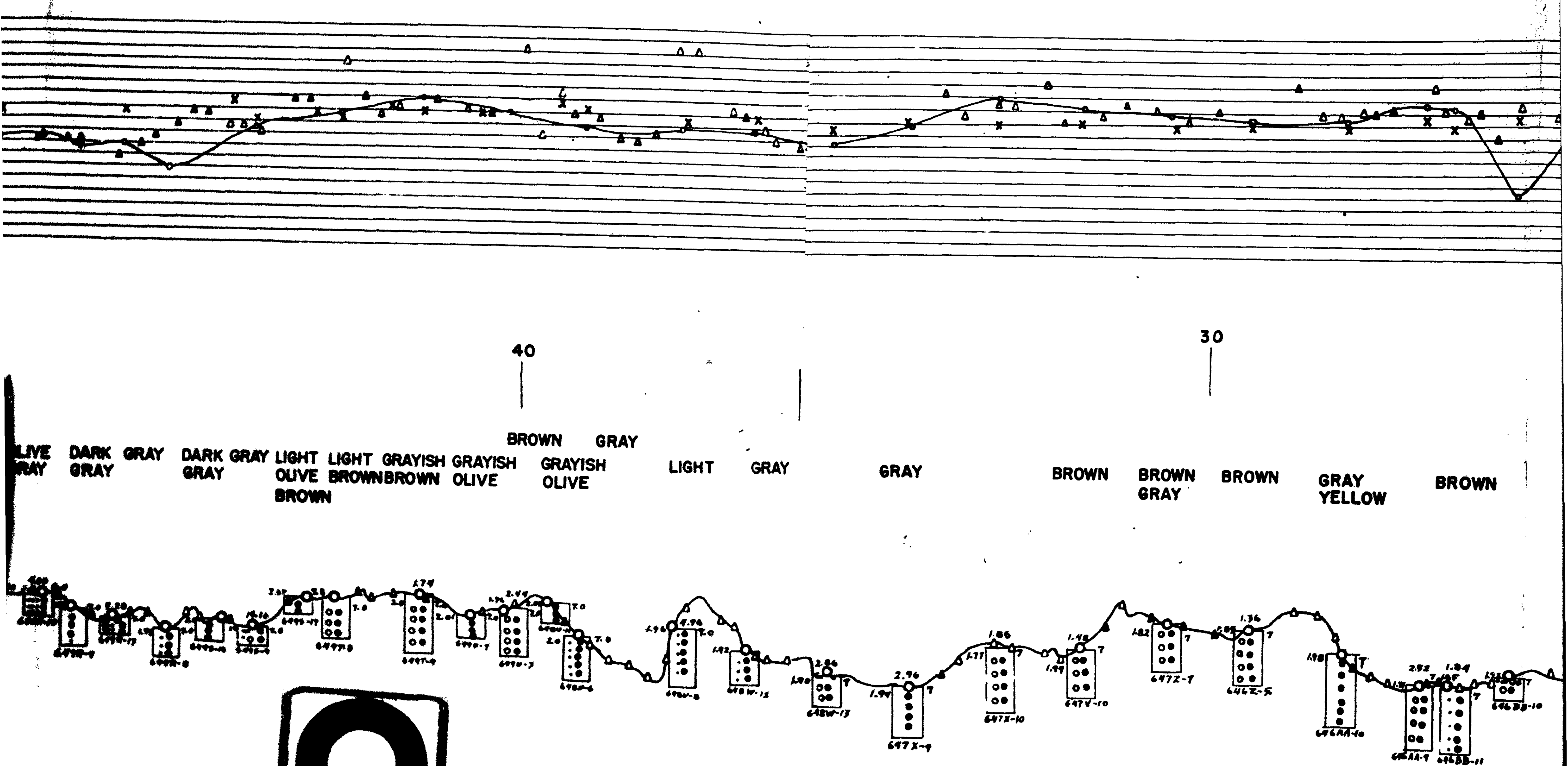
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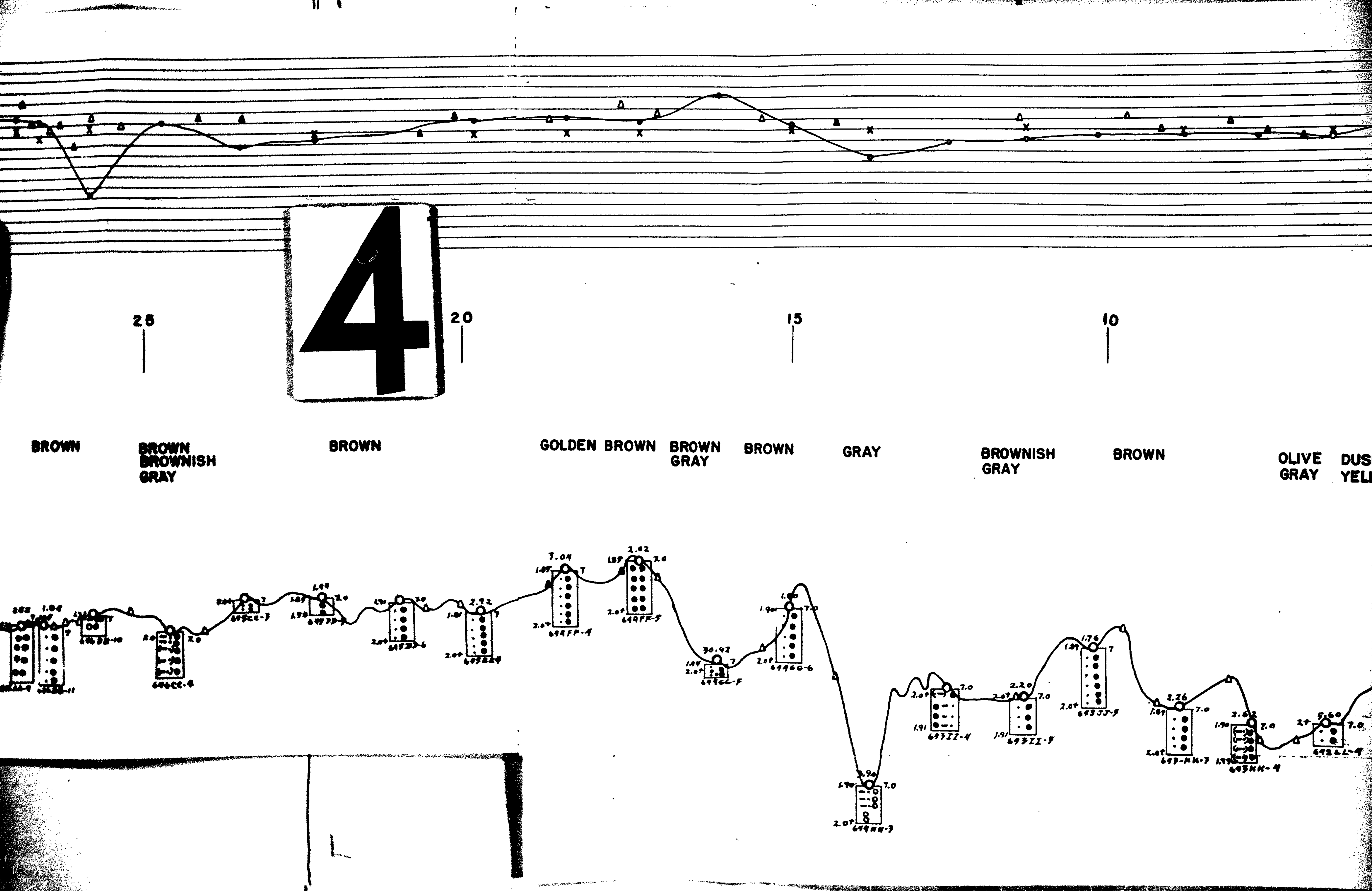
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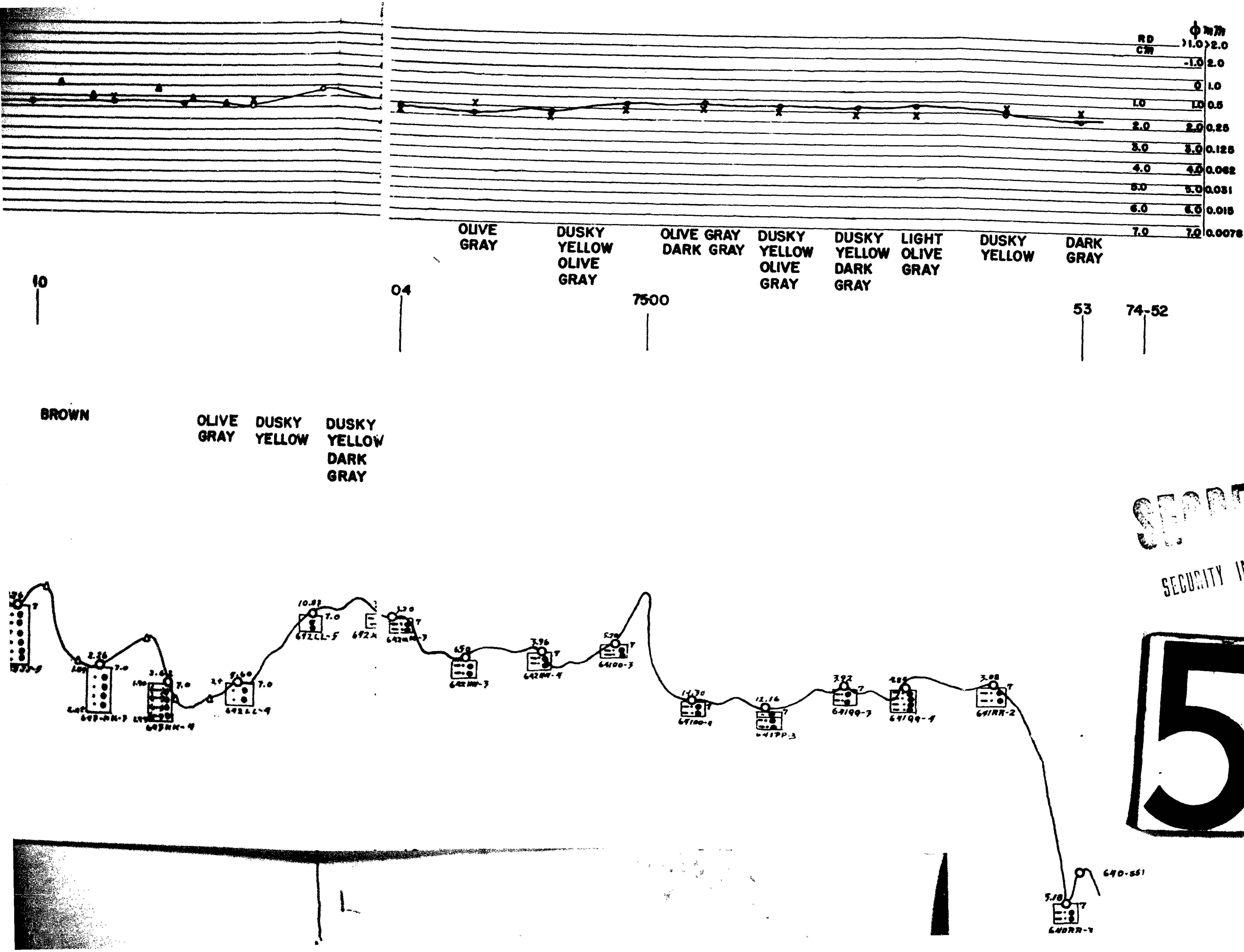

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